BIOGAS WORLDWIDE

INDUSTRY ANALYSIS AND FORECAST

JULY 2023

INTRODUCTION

- Biomethane is basically purified biogas that can be used as a natural gas substitute. It is a renewable fuel produced when organic matter or animal waste is broken down by microorganisms in the absence of oxygen.
- The production of biogas is stable and does not suffer from the fluctuations seen with wind and solar.
- Low carbon biomethane can be converted into green hydrogen, or hydrogen can be converted into biomethane when mixed with biogas' CO_2.
- Today, the biogas market is not very large, but is expected to develop faster in coming years as demand in various applications increases (i.e., electricity, heat, vehicle fuel, upgraded biogas, and cooking gas).
- Incorrys expects this renewable resource to grow at an average annual rate of 5% to 2030.
- Incorrys expects that global biogas power capacity will exceed 35 GW and generation will reach 1000 TWh in 2030.
- Europe, followed by China and the US, have the largest amount of biogas generation.
- Biogas could be used to support intermittent renewable electricity from wind and solar.

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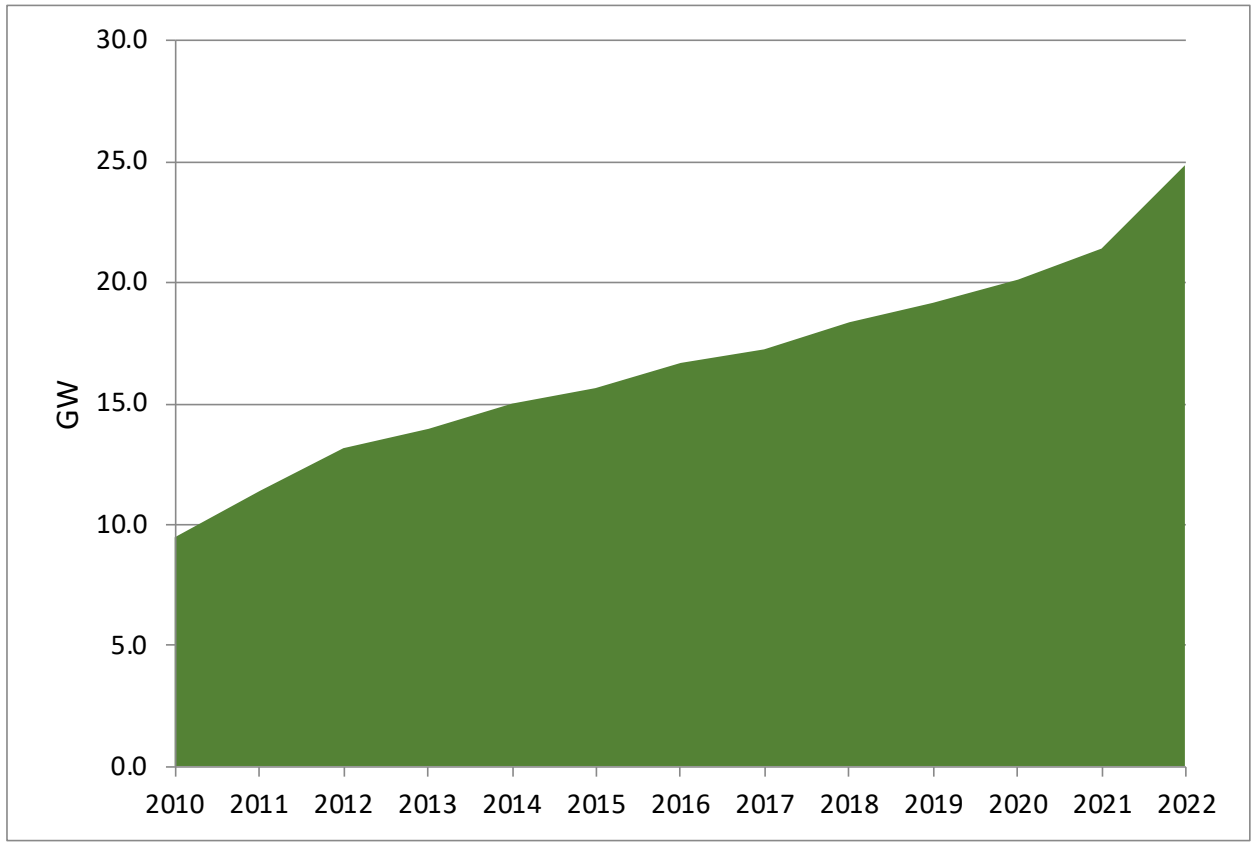
BIOGAS POWER GENERATION CAPACITY 2022



Electric generation from biogas is becoming a major trend in many countries, such as Germany, China, and India.

Typically, conversion of biogas to generate electricity is done utilizing a generator although it can also be generated using fuel cells.

Global power generation capacity from biogas has grown over 2.5 times since 2010 from under 10 GW to almost 25 GW in 2022.

The latest International Energy Agency (IEA) report shows 2022 being a record year for biogas increasing 3.4 GW (about 16%) compared to 2021.

The IEA also reported that almost two-thirds of biogas production in 2018 was used to generate electricity and heat (basically split equally between electricity-only facilities and co-generation facilities). Germany led the way followed by the US and the UK.

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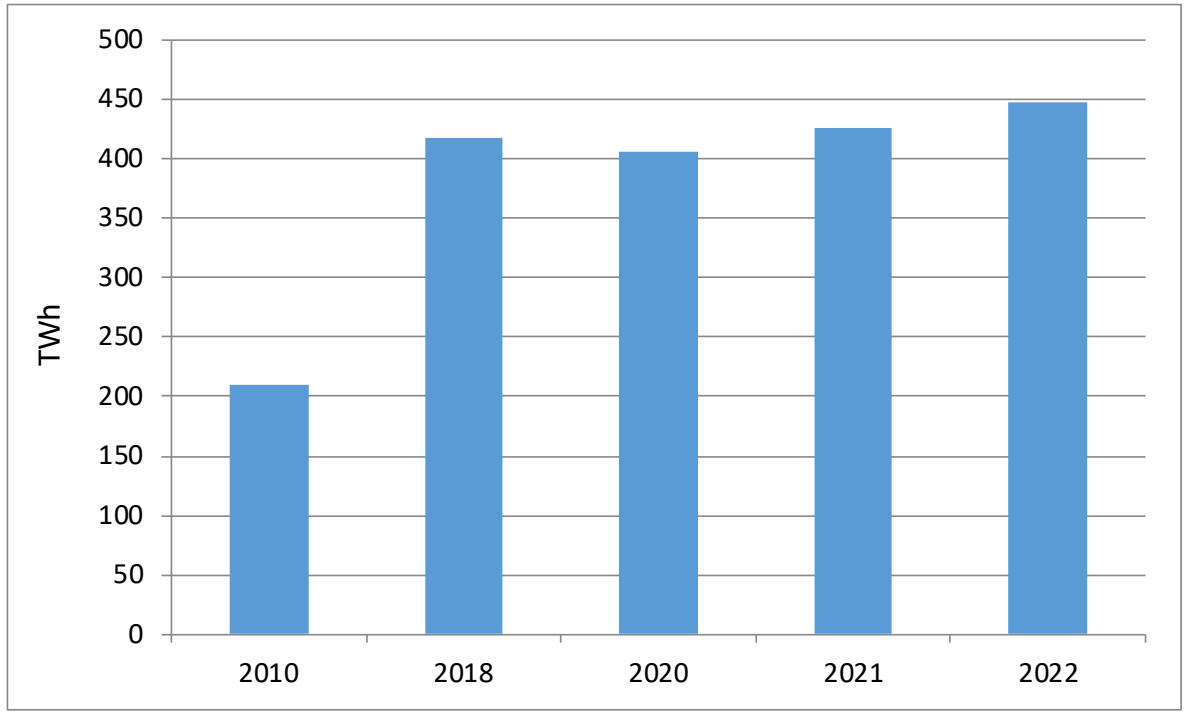
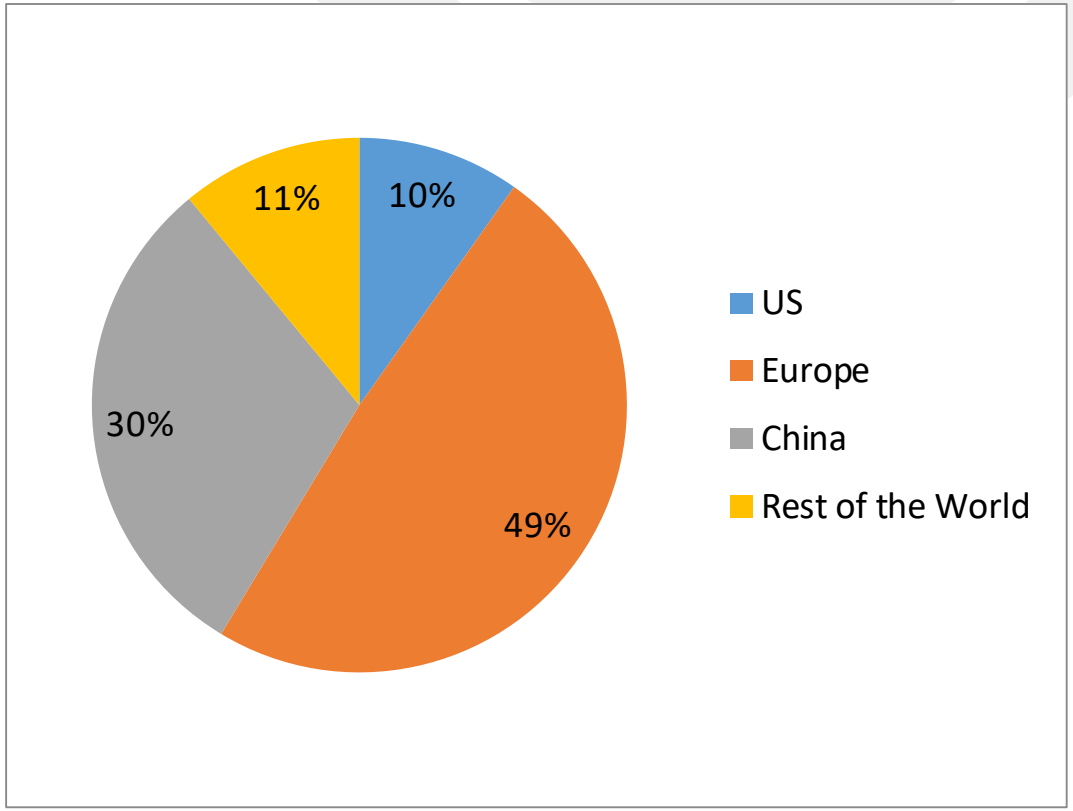
BIOGAS POWER GENERATION IN 2022



Biogas fueled power generation has more than doubled worldwide since 2010 increasing from 210 TWh to almost 450 TWh in 2022. However, it has seen limited growth since 2020, slowed by the impact of the Covid pandemic, increasing just 10% over the past couple of years.

The biomethane market (as a part of biogas market) is relatively small today although many regions are showing significant interest for its potential to deliver clean energy while utilizing existing infrastructure.

In 2022, almost half of global biogas generation was in Europe with China accounting for about 30% and the US 10%. In total, these 3 regions represented 90% of the global biogas [power generation.



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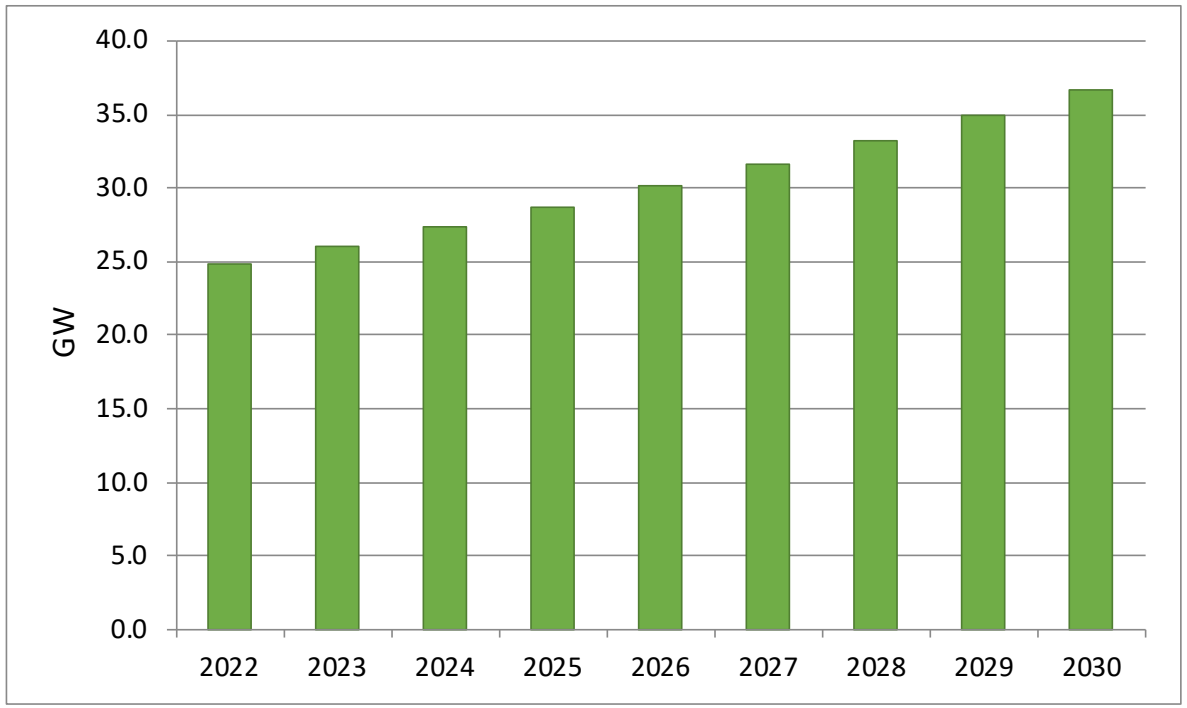
BIOGAS CAPACITY FORECAST 2022-2030



Biogas/biomethane use is small compared to other energy sources. They only account for about 5% of the total bioenergy market, which in turn only represents about 10% of global primary energy, so considerably less than 1% of global primary energy.

Incorrys expects the global biogas market to grow over the coming years due to increasing demand and amount of biogas construction activity.

According to Biogas World, there are about 2700 biogas projects worldwide of which more than 30 are in various stages of development.

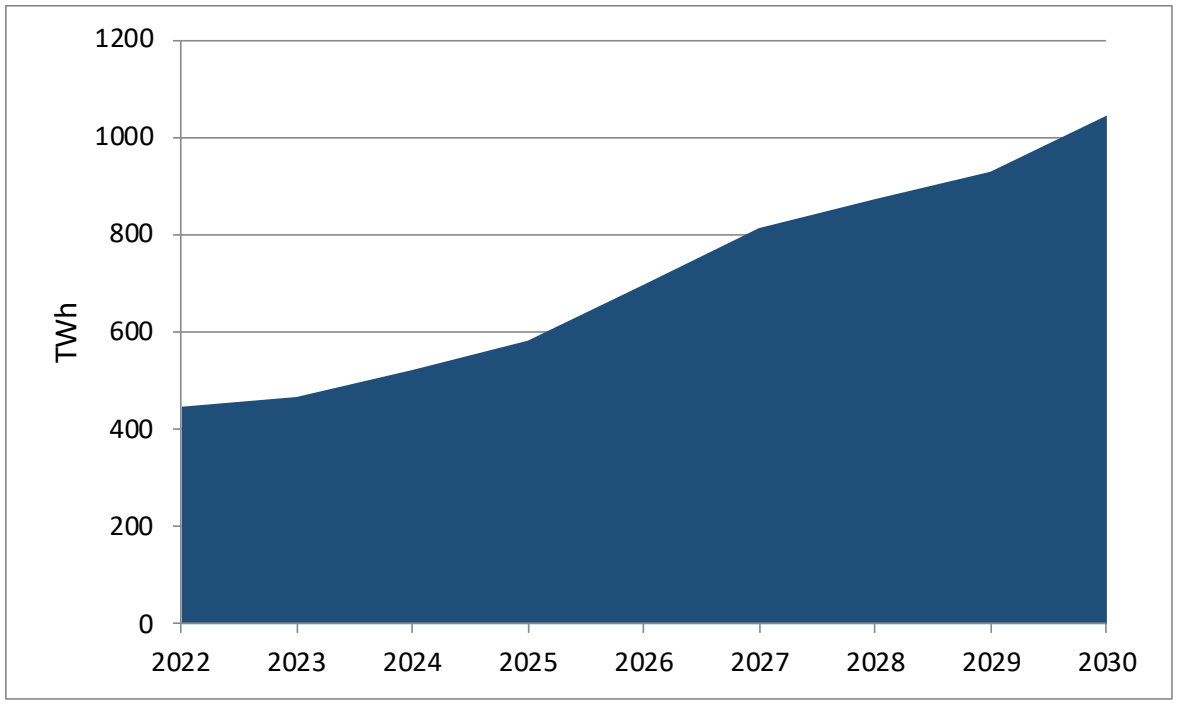
Biogas World's research shows that there are at least 230 renewable natural gas (RNG) facilities in various stages of development in the US and Canada; about 75% more than the 300 plants currently in operation.

China is seeking to expand rural biogas production to reduce air pollution from coal while improving waste management practices. They plan to reach a level of nearly 17 Mtoe (200 TWh) by 2030 from around 10 Mtoe today; an achievable target.

Europe, with a focus on biomethane production, reached over 1300 producing facilities in early 2023. The largest producers, in absolute terms, were Germany, the UK, Denmark, and France.

Incorrys expects the global biogas growth rate to be at least 5% annually through 2030 resulting in worldwide capacity exceeding 35 GW.

BIOGAS POWER GENERATION FORECAST 2022-2030



Incorrys expects that biogas power generation will grow year-over-year at an average annual rate of about 5% from 450 TWh in 2022 to more than 1000 TWh in 2030.

Most of this growth comes from centralized plants that are fed by agricultural and municipal solid waste sources to meet local power and heating demand.

New entrants in biogas production, like Africa, are expected to increase their presence in the global market. By 2030, an additional 200 million people (half of whom are in Africa) are expected to use biogas and move away from their reliance on traditional solid biomass. Africa has the potential to provide nearly 50 Mtoe of locally produced low-carbon biogas.

The Asia Pacific region sees, by far, the largest growth driven in large part by China and India. China's share in 2030 could exceed 40%.

Biomethane will comprise an increasing proportion of total biogas production going forward.

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ADVANCED ANALYTICS

Incorrys performs data analysis to ensure quality and consistency among different industries and jurisdictions

ACCURATE FORECASTS

Incorrys employs proprietary forecasting methodologies to ensure accurate forecasts of trends in different industries.

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